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ABSTRACT

This paper analyzes the organizational strategies and dynamics of cooperation appropriate to research consortia. The experiences of nine existing research consortia are reviewed in an effort to propose guidelines for practice in the design of research consortia, and to expand understanding of the nature of interinstitutional cooperation. The nine consortia studied are: Associated Western Universities, Corporation for Science and Technology, Microelectronics Center, Oak Ridge Associate Universities, South-East Consortium for International Development, Southeastern Universities Research Association, Southern Regional Education Board Faculty Research Grant Program, Universities Space Research Association, and University Corporation for Atmospheric Research. The study found that the forces behind pressure for cooperation in research include resources restricted by the growing impact of the federal deficit, the increasing expense and capacity of high technology research facilities, state-level concern for economic development, and the role of higher education as economic partner with business. Organizational characteristics that facilitate cooperation include, among others, participation of entrepreneurial faculty, achievement of success in one major project, which can lead to additional areas for cooperation, and use of political and corporate endorsement and participation to break down rivalries among institutions. Case study summaries of the nine consortia are presented in an appendix. (39 references) (JDD)

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The Decline of Competition:
A Study of Cooperative Approaches to University Research Management

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ASSOCIATION FOR THE STUDY OF HIGHER EDUCATION

This paper was presented at the annual meeting of the Association for the Study of Higher Education held at the Red Lion-Jantzen Beach in Portland, Oregon, November 1-4, 1990. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

ABSTRACT

The Decline of Competition:
A Study of Cooperative Approaches to University Research Management

Evolving expectations of university research, when combined with changing funding conditions, are compelling higher education to evaluate the suitability of traditional modes of research funding and management that have been based largely on competition. New forces suggest that cooperative approaches also must be considered in order to respond to these new conditions. This creates organizational problems for institutions that traditionally view research administration as an individual and competitive activity. The organizational strategies and dynamics of cooperation appropriate to research consortia are not well understood. This study found that the forces behind pressure for cooperation in research include not just resources as restricted by the growing impact of the federal deficit, but also the increasing expense and capacity of high technology research facilities, and state-level concern for economic development and the role of higher education as economic partner with business. The experiences of nine existing research consortia are reviewed in an effort to propose guidelines for practice in the design of research consortia, and to expand understanding of the nature of interinstitutional cooperation. Through interviews and document analysis, the organizational characteristics that facilitated cooperation in the examples are identified and discussed. It was found that while contextual factors related to organizational purpose and regional conditions restrict comparisons, there are common features that seem to be central to the viability of research consortia.

From its inception, American higher education has acquired an expanding array of purposes derived from its multifaceted relationship with society-at-large. Most of these purposes are reflected in the evolution of social, economic, political, and religious conditions that bind higher education to government, business and the community. This paper explores the changing role of university research in society and proposes that their are forces now at work that compel universities to consider alternatives to the traditional, competitive models of research funding and management.

In the past, strengthening the nation's research capability has been the responsibility of the federal government which relied on selected higher education institutions to conduct a substantial portion of basic and applied research for government program needs. This strategy of sponsoring research through the "top faculty researchers" or the "elite" education institutions has contributed to the development of research capacity to which the government turns for solutions to significant economic, social, political, environmental, health, and defense issues. This capacity to innovate, invent, and create is now feeling new pressures from government, business, and from within the academy itself. Each of these constituencies sees research differently, but all see it as a resource to meet certain purposes. The traditional approach to funding this research has been to give grants and contracts to individual researchers or institutions through highly competitive award processes (from which faculty and institutions drew a sense of prestige). Why does it now seem important, if not essential, to cultivate the higher education research resource in a cooperative manner?

First, the growing federal deficit makes it clear that campus-based research can not expect dramatic increases in research funding that has already become fairly stagnant. The National Science Foundation has challenged traditional approaches to research financing and announced an emphasis on awards to centers and groups in order to stress multidisciplinary research relevant to economic growth and development. "The center concept, which also encourages strong industry

participation and interaction, has created an entirely new research culture at universities" (Bloch, 1989). This announcement was a direct response to renewed debate between those who believe it is best to concentrate resources to avoid dispersion of increasingly limited funds, and those who contend that resources are already concentrated in too few institutions to the detriment of regional economies, academic diversity, and the promotion of innovation.

Also, the question of resources has been made more difficult by the high-cost, high-capacity equipment and facilities common to the high technologies that dominate today's research agenda. Many of these items essential to research have capacity far beyond that which can be consumed by a single institution. The ability of the federal government to support duplicate or in some cases merely replace research equipment has declined, and institutions must look elsewhere for funds to maintain or expand capacity. This has motivated many to enter into cooperative agreements with other institutions or with business (Keller, 1983).

At the state level, higher education policy issues fall under the broad umbrella of concern for quality and performance. These expectations are being expressed in state-designed or mandated assessment programs, budgets based on performance measures, state programs to provide fiscal incentives for quality improvement, and various programs meant to strengthen the link between higher education and economic development. Ewell (1989) suggests that current policy actions reflect a fundamental change in society's view of higher education - postsecondary education is no longer an intellectually autonomous industry, but is seen as a service industry that is an essential component of the solution to many societal and economic issues. Perhaps the major force changing the traditional view of research as a competitive activity is the increased expectation that universities provide the core of scientific research and innovation that motivates or maintains local economic activity.

In his March 1989 remarks before the Subcommittee on Science, Research and Technology, National Science Foundation Director Erich Bloch discussed the significant change in the way the nation views the importance of science and technology as components of economic

well-being:

> As a nation, we recognize that in many areas we can no longer take our world leadership for granted. That is equally true with regard to product competition in the world marketplace and also in research and technology. The world is highly competitive, and our ability to meet this competition is being seriously challenged in many areas...
>
> We also recognize that knowledge has become a significant economic resource -- perhaps surpassing in importance traditional natural resources and labor costs (p. 2).

A major consequence of this new awareness of the role of technological innovation and knowledge is the increased importance placed on higher education and campus-based research.

> Higher education institutions in the United States constitute the single most significant resource that can influence economic development. They provide education and training that expand our human capital. They conduct basic and applied research that generate new technologies, new products and new services. And they share the knowledge resources and the expertise that help transfer innovations from sector to sector and help American business maintain a competitive edge.
>
> Every sector of higher education, and every type of institution, plays one or more of these roles. . . More than ever, state policy makers, local government officials, business and labor leaders, and community groups are looking to colleges and universities for assistance in facing economic development problems (AASCU 1986, p. v).

The requests that higher education become a more prominent partner in economic development are accompanied by other conditions that have provoked a new look at traditional approaches to research. For example, past discussions of higher education and economic development have focused on the relatively few well-funded research universities. But now many states with stagnant or failing economies are expecting all their postsecondary institutions to play a part in economic renewal. Many of these institutions have limited experience in supporting research and public service activities, and are scrambling to respond to requests for research assistance and economic partnerships. The resources to revitalize areas with common conditions and needs may be distributed among a variety of institutions with different missions and expertise. Emphasis on this new role of research as economic engine suggests that solutions include the development of cooperative strategies among diverse institutions (AASCU, 1988).

Drew (1985) knew this when he made a compelling case for a "waste" theory in research administration. His argument is based on the notion that traditional research organization

paradigms are not well-suited to the current environment characterized by limited resources, pressure for results, and an emphasis on applied research. The pattern of funding individual researchers or institutions may overlook the intellectual and innovative capabilities of faculty and students at institutions not normally viewed as key research institutions. Drew saw many reasons for encouraging interinstitutional cooperation as a vehicle for sharing limited funds, tapping remote research talent, building diverse approaches to research management, extending research into industry, and retaining top quality faculty at diverse institutions. This is partly as a response to the powerful and expensive equipment and facilities required by many of the new technologies, and partly because of the uneven distribution of research capabilities among institutions and businesses (Dimancescu and Botkin, 1986). The proliferation of small, high technology businesses lacking experience in research and development activities complicates efforts to build successful liaisons (Logan and Stampen, 1985).

The differing perspectives of industry, universities, and government shape the forces behind new demands to approach some research projects through cooperative agreements among the three sectors.

The Industry Viewpoint

Industry approaches research with the view that research is a long-term investment whose function is to provide profit in terms of a product, process, or service.

Industry traditionally expects education to provide well-trained managers, a skilled work force, opportunities for renewing worker skills, and other development services. It also seeks a research base from which new products and services are developed for the market place, and seeks access to research expertise and modern laboratories. When industries examined their needs in the current economy, they began to recognize the importance of liaisons with higher education (SRI, 1986). Of the resources deemed essential for building new economic strength, the following were judged more important than location, resources, or inexpensive labor:

-accessible technology

-skilled and flexible work force

-entrepreneurial leadership

-availability of risk capital

Higher education is a major source of the first three of those four most important requirements for renewed economic infrastructures. While businesses look for faculty expertise, assistance with business plans, continuing education for employees, and cooperation in research, it is still productive personnel that are the most critical need industry puts on the shoulders of higher education (Gilley in AASCU, 1986).

At the same time, the university is a significant source of research that can be translated into commercial goods and services. The industrial community is aware that important university-based discoveries may be delayed in reaching commercial application because of delays in knowledge diffusion in academic circles. University-industry cooperative linkages often have as a major objective the flow of university research to the public market place.

Cooperative agreements have also become important because the potential for economic development has become increasingly vested on the hopes of small business entrepreneurs with advanced technological ideas, but limited resources. For these individuals, campus liaisons can provide access to faculty consultation, library and data base resources, and specialized equipment (Johnston and Edwards, 1987).

The National Science Board found the following reasons were given by industry as motivations for cooperation with higher education:

1. To obtain manpower (students and professors/researchers)
2. To obtain a window on science and technology
3. To solve a problem or get specific information unavailable elsewhere
4. To obtain prestige or enhance the company's image
5. To make use of an economical resource
6. To provide general support of technical excellence in research and education

7. To be good local citizens or foster good campus-community relations

8. To gain access to university facilities (1983, p. 34).

The University Viewpoint

Universities shape their attitudes toward research in light of diverse educational and research missions. A variety of conditions provide higher education with a strong motivation to give up a predominantly competitive approach to the pursuit of research support. As the federal deficit limits research funding, universities must look for new sources of research support and new ways of sharing resources or facilities. Like industry, higher education is finding many research activities to be unaffordable alone.

However, the motivation for universities to choose to cooperate with industry and/or, more often, with other universities is too often defined as being based primarily on financial motivations. The notion of economies of scale is a difficult reality to achieve and a harder one to demonstrate; many consortia fail in efforts to document cost savings (Baus, 1988).The National Science Board report on university-industry relationships in 1983 said it was too simplistic to say that universities are strictly motivated by needs for new funds. They found additional reasons, of which money is only a partial influence.

-industrially-sponsored research provides student exposure to real world research problems

-industrially-sponsored research provides a chance to work on intellectually challenging research that may be of immediate importance to society

-some government funds are offered only for joint agreements

-better training is available for students not pursuing academic research careers.

Therefore, the challenge for higher education is to meet the new demands imposed by government expectations and by financial conditions in ways that also serve to enhance their mission, expand resources, help recruit students, and provide stimulating research opportunities (SRI, 1986).

The State Government Viewpoint

It is largely the states, especially those with economic difficulties, that have actively

supported, funded, and promoted the participation of higher education in economic development and the importance of university-industry and campus-campus cooperative arrangements. State leaders have increasingly pressed for institutions to contribute to new products and processes for industry. Support has been offered in some cases to support specific applied research projects.

Many states have initiated activities in order to retain, expand, and attract new technology-based research and manufacturing firms. In 1985, 38 governors cited economic development as a top priority. In every case, this priority was linked to a recognized dependence on higher education resources and participation (Newman, 1987). An implicit assumption is that increased access to universities will make an area more attractive to business and will increase the probability that new home-grown advanced technology firms will be created.

States and communities are putting money into programs to lure new industries and renew decaying ones by building up technological abilities - turning knowledge into business success (Greenberg, 1987). According to the National Governors' Association (1985), state initiatives fall primarily into seven categories:

-policy development

-education and training

-research and development

-entrepreneurship training and assistance

-financial assistance to innovating businesses

-technology and information transfer incentives for institutions

-research and high technology industrial parks/incubators (p. 13-14).

NGA also reported that the two most prevalent modes of state sponsorship of research related to economic development are the university-affiliated technology research center and the applied research project grant. Often these projects have components requiring industry participation and/or financial matches from business.

State initiatives for cooperative agreements are quite numerous and have been surveyed in

several different ways.

The Office of Technology and Assessment found more than 200 state programs with features addressing technology development (1983). An AASCU survey of 300 institutions in 1985 reported that 97% were involved in economic cooperation with government and industry. Logan and Stampen, in a 1985 survey of comprehensive colleges and universities, found 128 government-funded programs for business-university ventures.

In 1986, the Maryland State Board for Higher Education conducted a survey of the 50 states on state initiatives to retain, expand, or attract industry. Forty-one states responded with descriptions of 110 programs. The most common models of programs were:

-sponsoring research and development at universities

-improving the educational system from top to bottom

-training workers in technical skills

-encouraging business to draw on academic resources

-providing incentives for technology-based firms.

The most recent study, prepared by the Minnesota Office of Science and Technology, shows that 44 states had at least one program, with a total of approximately $550 million of states funds being invested a variety of program activities such as research grants, technical and managerial assistance programs, and information network systems, most of which involve university cooperation (1988). These are grass-roots efforts involving local businesses, universities and government in combined focus on technology applications.

Federal and state programs have changed their approach of funding individual researchers to a strategy that stimulates the transfer of knowledge and promotes interinstitutional cooperation, multidisciplinary teams, and facilities-sharing among public and private sectors (Bloch, 1989). The new research strategy is one of collaboration for effectiveness and efficiency.

Purpose and Methodology

An increasing amount of attention is focused on the possibility that cooperative

management of research may result in more effective distribution of resources, facilities, and capabilities than past strategies that emphasized institutional competition. However, the organizational strategies appropriate to the design and operation of research consortia are not well documented or understood. This study considers the potential and the features of consortia for the administration of research programs. The analysis of nine examples of research consortia are analyzed based on the existing literature on interinstitutional cooperation and on the new perspectives on research organizations as they are shaped by government and business. The study of the identified examples revealed information about the fundamental characteristics of cooperative research models, guidelines that influence design and operation of research consortia, and new aspects of interinstitutional cooperation. From these cases, it is possible to suggest guidelines for practice and to gain new insights into the nature of cooperation.

Data for this paper were originally collected and analyzed in 1989 on behalf of the Western Interstate Commission for Higher Education.

The nine consortia were identified through the Council for Interinstitutional Leadership (which publishes a directory of consortia and identifies them by purpose), the National Science Foundation, the National Governors' Association, and the American Association of State Colleges and Universities. The search for research consortia quickly established that such organizations are hard to identify because they are often faculty-based and faculty-managed and tend to operate quietly and routinely without considerable public awareness or political visibility.

Nine organizations were identified for this study based on criteria suggested in the literature on cooperation (Patterson, 1979; Neal, 1988). While it is not possible to claim that the examples cited herein constitute the universe of cooperative research organization models, the extent of the search conducted suggests they are typical and representative of the forms that research consortia take in the higher education community.

The consortia were selected if they met the following criteria.

-existence of statutory authorization, formal charter and/or organizational constitution and

by-laws

-sufficient experience to provide longitudinal data on operations and outcomes

-record of success in obtaining ongoing financial support

-voluntary participation by multiple institutions, if not multiple states

-collaborative approach to governance and administration

-stated objectives to conduct/promote/facilitate research activity with at least part of the intent to be the support of research that has economic potential

Data for the nine case studies were drawn from individual interviews of staff of the organizations, some of which were by phone and some on-site. Substantial data were also generated by document analysis of materials describing the organization and operation of each consortium including, but not limited to, annual reports, constitutions, charters, state legislation, grant applications, audit reports, and media reports. Case reports were prepared on each consortium that described the following characteristics:

-original source of proposal for cooperation

-sources of financial support

-nature of cooperative objectives

-nature of relationships among and characteristics of member institutions

-the population served

-consortium management structure

-membership criteria

-outcomes and products produced from research activities

-apparent impact on economic development in service area, if known

The nine examples for which case studies were developed for this paper are listed below. Summaries of the case studies are presented the Appendix.

Associated Western Universities (AWU)

Corporation for Science and Technology (CST)

Microelectronics Center (MEC)

Oak Ridge Associate Universities (ORAU)

South-East Consortium for International Development (SECID)

Southeastern Universities Research Association (SURA)

Southern Regional Education Board Faculty Research Grant Program

Universities Space Research Association (USRA)

University Corporation for Atmospheric Research (UCAR)

The case reports were analyzed to answer the research questions: What approaches and organizational features have been used to facilitate interinstitutional cooperation for research purposes? What forces or practices hinder cooperation? To what degree is the role of research in economic development reflected in the structure and operation of research consortia? What guidelines for the design and operation of consortia can be drawn from an analysis of examples of interinstitutional research collaborative?

Findings of the Study

While an assessment of whether or not the subject research consortia have had an actual impact on their local economies is beyond the scope of this study, it can clearly be established that the origins of these organizations are vested in a belief that research activity is a vital ingredient of economic development programs. This belief is the product of traditional views of the role of research, evolving roles for higher education, a new economic climate, and new research conditions created by the requirements of advanced technologies. Most often, the central objective of the research consortium is to strengthen university-to-university relationships.In some cases, there was specific commitment also to strengthen university-industry ties. Not all the examples incorporated formal industrial participation in their operations. The nine consortia represent a wide

range of approaches to organizing cooperative research programs with variety in purpose, membership, operational style, and source of funding, as well as direct or indirect involvement in economic development.

Each of the example organizations is described in detail in Appendix A. For the purposes of this paper, a summation of the characteristics, rather than individual organizational details, will be discussed. By evaluating these examples along the dimensions used in the case reports, a set of features central to the design and operation of research consortia was suggested.

The Microelectronics Center of Massachusetts and the Indiana Consortium for Science and Technology are state-funded programs backed by legislative mandates. The original concepts for both came from a coalition of science and business researchers with legislative positions or influence. In some ways, these could be viewed as versions of "incentive funding programs" which are a fiscal device used by some states to entice higher education into cooperating with certain state expectations, most important being the development of new technologies and innovations to promote economic revitalization and entrepreneurship among both faculty and businesses. As state-supported programs, these two examples involve many of the state's institutions, and faculty research expertise is central to the achievement of organization goals. The programs are established as nonprofit corporations not affiliated with any single campus or system. Future funds must depend either on the legislature or on the generation of royalty income from consortia services and/or products developed through technology transfer. Faculty impact on management of operations is vested in those faculty who are on the board of trustees or operational committees and there is strong participation from business.

Dimancescu and Botkin (1988) suggest two main dangers for state-initiated programs dependent on public funds: they may lack the critical financial mass necessary to have dramatic impact on institutions or businesses; and there is a high risk of ongoing political intervention in purposes and management. They found the Microelectronics Center in particular had a slow startup because political disagreements made it difficult to begin operations with a strong

consensus. The competing or conflicting interests of potential participants were not worked out and valuable time was lost in working out disputes. This may be attributed in part to the failure to build an underlying faculty-based coalition of support for the original concept.

The Southern Regional Education Board (SREB) program for Faculty Research is also funded by state legislatures, but was the creation of institutions through interested individual faculty who needed to share access to research facilities across state lines. Its most direct economic impact is the avoidance of duplication of facilities and equipment. This program capitalized on the already existing pattern of state funding and cooperation on a regional basis through SREB itself. The exchange has no aspirations to expand beyond the limited activity of faculty exchange for access purposes, and has not used the existing regional communication structure to promote additional collaborative efforts in research development, management or funding. This seems to be the result of the fragility of state funding -- states routinely drop in and out of participation as state financial conditions change and restrict the ability to contribute to program support. Rather than having a clear economic development relationship, this program seems to live at the mercy of economic fluctuations. But within its scope, it is deemed by participants to be enormously successful and valuable.

The South-East Consortium for International Development is an example of a purely faculty-based organization solely focused on the purpose of sharing information on research expertise in order to facilitate collaborative grant applications and research projects. This organization has a narrow area of subject interest and demonstrates how a grass-roots effort can build and support an infrastructure that serves to increase research capacity without the foundation of a major startup grant or appropriation. In that respect, it is atypical of the examples studied. It has no stated economic objectives other than to maximize the quality and efficiency of research through cooperation among like-minded faculty. However, it is a fine example of how faculty who share the same research objectives, but happen to be from many different states, can voluntarily create a support network that has been extremely successful in winning research funding, and has led to the

creation of a central support staff for the organization to facilitate future activities. This organization was largely the result of one person's efforts to identify research partners. It continues to be supported by management fees associated with contracts won, but the budget conditions of the '80s have recently compelled them to introduce a dues structure to avoid debt. A board member interviewed for this report suggested there is strife between and among staff and board members over the desire of professional staff to expand their authority on who competes for what funds. Without more formal interinstitutional compacts, few campus administrations are willing or able to relinquish research decisions to a consortium arrangement operated at the faculty level.

Universities Space Research Association (USRA), Oak Ridge Associated Universities (ORAU), and University Corporation for Atmospheric Research (UCAR), are large organizations supported by the funds derived from their role in managing major federal contracts. Though these are, in the eyes of many institutions, quasi-federal agencies, they were actually designed and continue to be managed by faculty-based expertise. The expressed need of federal agencies to achieve some sort of coordination among the academic community serving specific (and costly) areas of research may have been the catalyst for bringing the faculty together, but the operational structure and management style of these consortia are very much the style and form of academic researchers. As such, they operate as cooperative research centers. They have proven to be flexible in their ability to connect research outcomes to economic development, though this is strictly limited to areas reflecting the underlying academic objectives of their research. They seem wary of appearing to be too closely connected with industry although such research partnerships are becoming more common. These organizations have large financial resources and world-class facilities at their disposal so long as federal commitment continues. They have succeeded in building vital support from universities and colleges through the image of prestige associated with membership and participation. Each has recently intensified efforts to raise funds from industry and foundations, reflecting a desire to broaden the diversity of fund sources and reduce federal

dependency.

The Associated Western Universities (AWU) is also dependent on the continued availability of specific federal programs and has been successful in earning campus enthusiasm for its existence. This is attributable to the specific nature and narrow focus of the central program which AWU serves, and to the fact that its efforts are of a direct, tangible benefit to individual faculty and students. Institutional participation is clearly an important augmentation to what campuses can provide in the way of research facilities and intellectual collaboration. Beyond the preparation and encouragement of current and future faculty researchers/scientists and probably some cost avoidance by preventing duplication, it is not clear what direct impact AWU may have on economic concerns. The compactness of its performance objectives apparently enables it to achieve much with a small staff and budget. Faculty involvement, academic leadership and communication among those groups with common interests is central to its success and support. The organization is praised by users as efficient, and as providing a critically important service. There are apparently no direct connections to regional businesses, rather the emphasis is on relationships among universities and between campuses and government labs.

The Southern University Research Association (SURA) is another example of how one strong faculty personality can serve as the magnet to build an action plan around a common need for a particular research facility. While organizations such as UCAR have enormous resources and critical personnel mass to reinforce the notion that in federal competitions, winning often begets winning, SURA is a case where a small coalition of faculty from several states organized a successful competition for a major research facility. By using faculty experts to identify areas of critical importance to regional needs, SURA has been successful in winning a blend of federal, state, local, and institutional support, and aspires to gain industry support as well. By demonstrating to each sector the value of its projects, SURA has built a coalition of political support around an academically-managed enterprise which can respond flexibly to changing regional needs. As a small organization it has structured itself to draw on the influence of

governors, campus presidents, and distinguished faculty, thereby developing an ability to compete against organizations with much larger funds and staff. It offers the campuses assistance in recruiting and retaining faculty, it offers economic development opportunities to states, and it has raised the esteem of member states that previously felt inadequate in their ability to compete for major facility or project awards. Its political support and state/local financial support was a direct result of an ability to demonstrate the economic potential of SURA projects and facilities. Though it invested all its eggs in the basket of the one original facility proposal for which it was created, SURA has shown its formula for cooperation has staying power by funding and organizing additional activities such as SURANET, a regional communications consortia that was a critical need for the region's institutions.

Six of the consortia had goals and purposes specifically related to economic development activities, although obviously some were of much greater scale than others. The three that did not have specific economic objectives or industry ties all shared two significant characteristics: they operated primarily by and directly for the benefit of faculty, staff and/or students; and they claimed as a purpose or achievement the reduction of costly duplication of facilities and resources including the intangible benefit of shared intellectual resources. Their notion of economic efficiency was thus expressed through terms of cost avoidance.

Conclusions

The data on these organizations were interpreted in the light of literature on interinstitutional cooperation in order to identify dimensions of cooperative research organizations that seem most central to viability. Although Baus (1988) tells us that it is not particularly helpful to study the peculiar or unique roles of consortia because they are too varied and complex to provide useful information outside of the individual consortium context, he also reminds us that there are conditional roles that are worth investigation when seeking to understand the nature of interinstitutional cooperation and the forces that facilitate cooperation.

However, one should not dismiss consortium activity as defying analysis. There are

> conditional roles for consortia that tend toward the generic and the prescriptive, and away from the idiosyncratic. The conditional roles of consortia are those activities that a consortium ought to attempt because there are conditions higher education faces that logically call for institutional cooperation as a response. These conditions may be transient, but they do exist and can be defined -- and, therefore, systematically studied (p. 27).

The conditional roles and purposes of the subject organizations examined for this study suggest the following set of guidelines that contribute to the design and operation of research consortia:

-Building successful programs depends on the participation of entrepreneurial faculty

-Coalitions of support can be built, areas of need identified, and strategies designed through the use of faculty seminars and special interest committees during start up phases

-Although project ideas are best left to faculty, successful organizations that are regional in character and have strong relationships to economic development are those that involve campus and political leadership, and sometimes, corporate leadership in the organizations' governance structure

-A focus on one major project at first can promote success and lead to additional areas for cooperation

-Federal or state support is critical to survival, at least in the start-up phase; dues from institutions or foundation support are not adequate - it is beneficial to have diverse funding sources over the long term

-Rivalries between institutions can be broken down by political and corporate endorsement and participation, and by sound organizational research that documents common academic and economic needs in relevant research fields.

In searching for the research consortia analyzed for this study, a number of failed attempts to organize research cooperatives were also discovered and reviewed. These also displayed common characteristics that further reinforce the dimensions of cooperation listed above:

-Lack of a common, compelling mission

-Inaccurate assessment of collective capacity or need

-Inadequate fund planning or management

-Lack of necessary political or administrative coalitions or endorsements.

Additional study of failed interinstitutional organizations may be of value in furthering an understanding of the dynamics of cooperation.

The most compelling lesson of this study was the role of the faculty in creating and building successful coalitions for research purposes. Previous research confirms the importance of faculty commitment:

> The most successful interactions are almost always initiated by a key individual who is energetic and has a belief that the success of this program is essential...Very rarely do programs succeed which are developed conceptually at the top levels of university administration. There must be enthusiastic faculty support of the program (Langfitt, 1983).

The common characteristics that apparently contribute to organizational performance suggest central questions which those who seek to initiate new consortia might consider.

What is the mission of the intended consortium?

What strengths exist in the region to support the mission?

What attitudes exist toward targeting a specific research focus or a specific type or category of industry to assist through research activity?

How much money and what human resources are available to support program start up?

How does the proposed consortium complement or conflict with existing private, state, or federal programs in the region?

The Future of Research Cooperation

Cooperative research coordination is an area where there is much creative movement, and an area where universities are seeking more efficient uses of intellectual, financial, and physical resources for research through formal cooperative strategies.

Rarely can a structure developed by one consortium be perfectly translated to another environment, but fundamental approaches and strategies can be emulated. Collaborative agreements can be replicated with consideration given to contextual issues relevant to the new organization. The value of understanding these examples of cooperation becomes significant when

individual institutional requirements for funding competitions, libraries, facilities acquisition, and staffing are taken into account. The symbolic, beyond the functional, importance of cooperation for research is a topic for additional research on the role and potential of cooperation. An understanding of both roles will be central to justifying additional investments in cooperative efforts. While foundations and federal agencies may provide selective funding, increases in state and business support are clearly essential if cooperation is to become a feasible, typical, and not the extraordinary, alternative to competition for most research programs.

Cooperation in research is not a panacea for inadequate research funding or for the problems of economic revitalization. There are many barriers to cooperation, including competitive traditions, inadequate time, and concern for autonomy. The examples analyzed in this study suggest some of the factors that can help overcome such barriers. Additional research into the factors that facilitate interinstitutional cooperation is needed.

Research consortia are most often of a voluntary nature, and as such, the initial motivation for their creation has generally originated within the participating institutions or among researchers. However, increasing interest in the role consortia can play in regional planning and development has been shown by states and regional organizations. Many sectors now realize the contribution consortia can make toward enabling institutions to facilitate research. Cooperative research interactions require cooperative planning, and recognize fundamental interdependencies in the research academy. The overall health of such research activities is often bounded by similar economic, demographic, political, philosophical and social pressures within states and regions.

This study has attempted to illustrate some of the diverse approaches that have been taken and the resulting impact on the character and operations of the example research consortia. Understanding the benefits and potentials of regional approaches to research are central to responding to the public's call for universities to play an increasingly central role in economic development.

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APPENDIX

EXAMPLES OF ORGANIZATIONS THAT PROMOTE RESEARCH THROUGH COOPERATIVE STRATEGIES

ASSOCIATED WESTERN UNIVERSITIES INCORPORATED (AWU)

Location: Salt Lake City, Utah
Founded: 1967
Membership: 38 colleges and universities
Funding Source: Department of Energy
Membership Dues
Annual Budget: $2.21 million
Administrative/Operations Costs: $265,000
Size of Staff: Five
Focus: AWU manages the Department of Energy University-Laboratory Cooperative Program for DOE supported laboratories in the western U.S.

AWU plays the role of broker by matching and evaluating the research interests and capabilities of academic scientists with research opportunities in laboratories. The most qualified students, faculty, and recent graduates are awarded fellowships as visiting guest scientists at host laboratories, thus gaining access to the vast and often unique personnel and resources available in those national facilities.

Since 1967, AWU has provided grants to more than 5,000 scientists. The consortium was established because the universities, now 38 member schools, recognized that a mechanism was needed to effectively and economically administer educational and training activities resulting from the interface of western institutions and DOE laboratories.

A Lab Co-op program has four elements: Student Research Participation Program, Graduate Research Participation Program, Postgraduate Research Participation Program, and Faculty Research Participation Program.

Student fellowships attract academically superior undergraduates into science disciplines by giving them a hands-on experience. Undergraduate internships allow students to alternate research work in a lab with academic studies on campus. Laboratory Graduate Fellowships give graduate students the opportunity to conduct thesis research in a cooperating lab. Thesis Parts Fellowships specifically support graduate students who cannot complete their research on their own campus for lack of facilities. Postdoctoral fellowships offer recent graduates the opportunity to continue in energy-related research with fellowships fully-funded by the cooperating labs. The faculty program is intended to generate new research ideas through interaction of laboratory and academic scientists, fostering the exchange of information, and improving the teaching and research abilities of the faculty.

In 1988, AWU established a seven-member Laboratory Advisory Board from among its scientific contacts at each lab. This has furthered AWU objectives by establishing a communication network to identify research opportunities within each laboratory and evaluate AWU programs from the laboratory viewpoint.

In 1988, AWU provided 387 awards to scientists and engineers from 134 colleges and universities to pursue research at 22 laboratories.

CORPORATION FOR SCIENCE AND TECHNOLOGY (CST)

Location: Indianapolis, Indiana
Founded: 1982
Membership: Voluntary: all postsecondary institutions are eligible
Funding Source: State appropriation
Annual Budget: Approximately $10 million
Administrative/Operations Costs: Approximately $250,000
Size of Staff: Eight management staff plus support staff
Focus: High technology research and development grants to business and university partnerships, technological advice, and business counseling

CST is a partnership of business, government, and universities. Established in 1982 by the Indiana legislature, its mission is to contribute to the strengthening of the economy of the state through the development and application of science and technology. Goals include fostering communication through a committee network of technical experts, encouraging technology transfer between universities and industries, and facilitating programs in scientific education. Its major goal is to identify scientific and technological problems and opportunities related to the economy of Indiana and to fund proposals addressing them. It is a private, not-for-profit company governed by a 25-member board of directors representing government, business, and university sectors.

An interesting feature of CST's operating design is the use of volunteer faculty and industry experts on independent committees guiding the selection of priorities and projects for each of the broad areas of technological interest identified by the board. At this time there are 13 such technology-focused committees.

The committees select priorities and award contracts, but their most positive activity appears to be their success as an informal network for information exchange among the interested sectors. The committees are large and inclusive with 20-60 members each. Every committee involves multiple higher education institutions.

A novel aspect of CST funding is that awards are in the form of conditional loans with a royalty-based payback. These paybacks are to be reinvested by CST, and ostensibly will eventually reduce the need for public appropriations.

The mission statement of CST includes the goals of establishing university-industry connections which are consistent with the educational function of the universities; advising universities of the research needs of private business, improving the exchange of scientific and technological information for the mutual benefit of universities and private business; and determining how public universities can increase income derived from the sale or licensure of products or processes having commercial value that are developed as a result of university-sponsored research programs.

MICROELECTRONICS CENTER (MEC)

Location: Westborough, Massachusetts
Founded: 1982
Membership: Ten academic institutions
Funding Source: Capital funds:
$20 million startup appropriation from state
$30 million in industrial sponsor contributions
Annual Budget: About $3.3 million made up of state support, grants, contracts, and other activities
Administrative/Operations Costs: Approximately $760,000
Size of staff: 10 of the total of 40 employees are general administrators
Focus: Supporting educational institutions in their efforts to improve engineering education and research as a strategy for attracting and retaining high-tech companies in Massachusetts

The Massachusetts approach is education-based. The idea is that to help universities provide modern facilities to students and faculty for research and education will help industry and thus help the state's economy. The participating universities are not asked to contribute any funds to the center's operation; it is a partnership of state and industry in service to education. Ten participating universities have shared-use access to the center's advanced facilities which include such features as a state-of-the-art, computer-aided design center and integrated circuit fabrication facility for students to produce their own designs of computer chips. In addition, industry-purchased equipment has been installed at each school for local use. The approach was proposed in 1982 when area high-tech companies complained to the state that the universities were limited in their ability to offer expert education and research programs because of a lack of laboratory facilities and equipment.

The center now provides, in addition to central technical facilities and satellite laboratories, support of continuing education programs, and facilitation of campus faculty recruitment and development. More than 2,000 students participate in center programs.

This center is governed by a 23-member board of 10 academic, 10 industrial, and three state representatives. An objective is to reduce dependence on state appropriations by providing fee-based services to industry. However, administration makes it clear that such services will not in any way compete with services available through university-based operations performed in cooperation with industry. Staff also suggested that a positive outcome of faculty participation in center programs was an increase in interinstitutional cooperation and increases in program distinctiveness among the institutions as each develops special interests and unique industrial relationships.

OAK RIDGE ASSOCIATED UNIVERSITIES (ORAU)

Location: Oak Ridge, Tennessee
Founded: 1946
Membership: 49 Universities
Funding Source: Department of Energy (74.3%)
Other U.S. agencies (14.2%)
Private sector (9%)
Corporate sources (2.5%)
Annual Budget: $35 million
Administrative/Operations Costs: $654,000
Size of Staff: Approx. 45 officers, division heads, directors
507 employees
Focus: To foster, encourage, and engage in the identification and development of solutions to scientific, engineering, technical, medical, and human resource problems through the cooperation of DOE, member institutions, and other private and governmental organizations.

The mission and purposes of ORAU (paraphrased) are:

-to facilitate the use of DOE laboratories and other facilities by qualified university research personnel;
-to assist in the development of research and educational programs in the universities and colleges of the southern region;
-to foster, encourage and conduct research for the southern region, the nation and other countries;
-to establish and operate facilities where and as required for the achievement of these purposes.

Although all of ORAU is involved through diverse mechanisms in the exchange of research information and liaison with campus researchers and students, it is the office now called University Services which takes cooperation, collaboration, and communication as its areas of focus. The goal is to increase the quality and quantity of research on member university campuses and to assist members in securing research funds to achieve improvements in research productivity. University Programs, in 1987-88, accounted for 29.9% of the total operating costs of ORAU.

Examples of cooperation include fostering research cooperation among institutions by providing financial and programmatic support to a series of workshops on selected research topics or issues. Another cooperative program is Visiting Scholars which helps faculty members visit other campuses.

Collaboration is supported by sharing information on equipment and programs, and by helping institutions obtain used research equipment from DOE through the Energy Related Laboratory Equipment program. ORAU is also interested in helping regional organizations prepare proposals for collaborative research centers.

SOUTH-EAST CONSORTIUM FOR INTERNATIONAL DEVELOPMENT (SECID)

Location: Chapel Hill, North Carolina, and Washington, D.C.
Founded: 1977
Membership: 33 colleges and universities
Funding Source: Membership fees based on a percent of awards received plus Management fees on contracts and grants with the U.S. Agency for International Development (AID)
Annual Budget: -$8 million
Administrative/Operations costs: $1 million
Size of Staff: 15
Focus: Providing a consortium approach for research on and technical assistance to less-developed countries

SECID is a consortium of 33 land-grant and historically Black colleges and universities who wish to work cooperatively in competing for government grants to provide research or technical assistance to developing nations. The idea is for the consortium office to provide the coordinating services to broker grants and build teams with necessary skills in order to compete effectively for awards. Members can, therefore, participate in projects too large or complex to be implemented by one institution. Thus, the consortium serves as a vehicle for sharing research opportunities and information on research expertise among institutions.

In addition, the consortium provides support services to project teams by handling contract management, financial services, communications, procurement and training.

Policies, procedures, and goals are set by a seven-member board elected by the membership. The trustees also hire and supervise the staff and monitor the annual budget. Each project has a Project Advisory Council consisting of faculty or trustees from the participating institutions, the team leader, a representative of the granting agency, and a representative from the project's nation(s). In this manner, SECID strives to ensure that each project meets its contract obligations.

In its history, SECID has managed 40 contracts, with more than one-half involving African countries. Projects focus on research and technical assistance in environmental management, agriculture research, institutional development, and procurement (agricultural resource management). The project awards have totalled more than $80 million.

SOUTHEASTERN UNIVERSITIES RESEARCH ASSOCIATION (SURA)

Location: Washington, D.C.
Founded: 1980
Membership: 35 institutions
Funding Source: Membership Dues
Department of Energy
National Science Foundation
Annual Budget: Grants of $500+ million over several years
Administrative/Operations Costs: $1.1 million
Size of Staff: Eight
Focus: To foster excellence in scientific research, to strengthen the scientific and technical capabilities of the nation and of the Southeast, and to provide outstanding training opportunities for the next generation of scientists and engineers.

SURA has two main projects under way. The Continuous Electron Beam Accelerator Facility (CEBAF) is now under construction in Newport News, Virginia. SURAnet connects 52 university and federal research networks, allowing participants to communicate with each other and to access National Science Foundation supercomputers.

Thirty-five full and three associate members comprise SURA. Full members pay a first-time fee of $10,000 followed by annual dues of $3,000. Associate members pay $3,000 to join, and $1,000 annual dues. The majority of the budget comes from management fees for the CEBAF and SURAnet projects. These funds have made it possible to institute a program of graduate fellowships in nuclear physics, accelerator physics, and other CEBAF-related fields of science and engineering. As many as five awards of $10,000 each will be made annually; summer employment at CEBAF as a research assistant can also be part of each award.

SURA started with a small coalition of faculty who wished to compete for the Department of Energy plan to build CEBAF. To assemble the necessary expertise and political force, 13-14 schools formed SURA and won the contract in 1983. Regional political endorsement and planning appropriations seem to have been a main ingredient in their success. SURA has now branched out to serve faculty in subject areas, and has won project support from state and local governments. The original proposal for SURA came from faculty who believed in a collaborative approach to grant funding. The organization is now administered by a Council of Presidents who elect new member institutions and the Board of Trustees which has actual policy responsibilities for the organization. The trustees are generally distinguished faculty researchers. The board is supported by five standing committees and by an elected executive committee, the president of which is responsible for the management of the organization's operations.

The SURA strategy is that direct interinstitutional links with facilities at the vanguard of scientific research makes it possible for regions to attract the best faculty and students with the resulting positive effects for business as well.

SOUTHERN REGIONAL EDUCATION BOARD FACULTY RESEARCH GRANTS

Location: Atlanta, Georgia
Founded: 1977
Membership: Six states on behalf of their public institutions
Funding Source: State appropriations
Annual Budget: $5,000-10,000 per state
Administrative/Operations Costs: Subsidized by SREB
Size of Staff: Two professional staff
Focus: Provide grants to faculty to use research facilities in other states

The Southern Regional Education Board (SREB) manages a former Sloan Foundation program which enables faculty of colleges and universities in six participating states to obtain supplemental support for travel to off-campus facilities to improve their research abilities. The small grants, usually less than $1000, cover modest expenses for travel and for equipment use fees. Participating states provide annual appropriations to support the grants.

The program is intended to encourage colleges and universities with uncommon equipment and facilities to make these installations readily available to researchers in the natural and social sciences and the humanities.

SREB administers the state funds on behalf of the institutions in each participating state and awards institutional requests for support until each years appropriation from that state is depleted. Due to economic fluctuations, some states move in and out of the program.

SREB does not have any other programs specifically geared to promoting cooperative research, nor does it have programs focusing on the promotion of economic development.

UNIVERSITIES SPACE RESEARCH ASSOCIATION (USRA)

Located: Columbia, Maryland
(Facilities in Texas, Virginia, California, Alabama, New York, and District of Columbia)
Founded: 1969
Membership: 62 universities
Funding Source: Grants, Contracts, Management Fees, Contributions
Annual Budget: $17 million
Administrative/Operations Costs: $1 million
Size of staff: 50 management staff
Focus: Acquisition and development of facilities for research, development and education associated with space science

USRA was created under the auspices of the National Academy of Sciences and has always been based on a consortium of universities, now numbering 62 across the nation. This group is chartered to provide a mechanism through which universities and other research institutions may cooperate with one another, with the government, and with industry, to further space science and technology. In fulfillment of this charter, USRA operates a number of institutes and programs for NASA.

The overall operations are overseen by a 14-member board elected by the representatives from each member institution. Also, each institute and program is overseen by a Science Council with membership from universities, industry and government. It is intended that these board and council members are not selected as representatives of their home organization, but for their competence and judgment. Policy and operational or priority changes in mission and projects are the responsibility of the Board of Trustees.

USRA now runs 12 institutes or programs which focus on bringing together faculty and/or students to facilitate cooperation in tackling various aspects of space research. USRA also conducts workshops, courses, peer reviews and assists in the development of NASA-university relations. Through USRA, faculty and students can access the considerable laboratory facilities developed by various NASA programs.

UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH (UCAR)

Location: Boulder, Colorado
Founded: 1959
Membership: 57 instititutions
Funding Source: National Science Foundation
Office of Naval Research
National Aeronautic Space Administration
Member dues
Annual Budget: $70.5 million
Administrative/Operational Costs: $5.5 million
Size of Staff: Approximately 370 of 883 employees are involved in administrative/support roles
Focus: UCAR is a nonprofit organization engaged in scientific and educational activities in atmospheric research and related fields

UCAR operates the National Center for Atmospheric Research (NCAR) under contract with the National Science Foundation and the Institute for Naval Oceanography. It also operates the Computer Science Research Network, (CSNET) which is funded by member dues and fees.

UCAR is a university membership consortium composed of 57 U.S. and Canadian institutions that offer a Ph.D. in atmospheric, oceanic, and related sciences. UCAR is governed by a board of trustees elected from the membership.

As a consortium, UCAR seeks to serve research needs in these particular science subjects by pursuing the following goals:

-Bringing together member universities to collectively undertake national and international research efforts;
-fostering interdisciplinary approaches essential to understanding Earth's systems;
-Financing equipment and facilities needed, such as advanced aircraft, instrumentation, computers and supercomputers, and advanced radar;
-Providing services to universities to advance teaching and research in these subjects.

UCAR began when NSF formed a working committee of 14 atmospheric scientists in 1959 to determine what facilities were needed, and subsequently to monitor the planning, construction, implementation, and management of what is now known as NCAR. Important moves to foster interinstitutional collaboration include using grants from NASA, NSF, and the National Oceanic and Atmospheric Administration to support an Office for Interdisciplinary Earth Studies which fosters relationships among disciplines and organizations to explore global change. Also, a visiting science program provides opportunities to campus researchers to access facilities. Agreements with industry have the objectives of getting the results of research transferred to the private sector and also to help generate financial returns which can further support research and development.